

fg
A Digest of Recent Soviet R & D Articles

CONTENTS

Vol. 2

April, 1976

(12)
No. 4

Academicians Predict Research Trends.	1
Trends in Semiconductor Technology	2
High-Sensitivity Superconducting Microwave Detector	3
Superconducting Microwave Frequency Converter	3
New High-Strength Polymer Fibers	3
New Heat-Resistant Synthetic Fiber	3
Polymers as Structural Materials	4
Optical Processing of Side-look Sonar Signals	4
Calculation of Explosive Magnetic Field Compression Generator	4
Tunable Dye Laser for Isotope Separation.	5
U. S. -Soviet Review of Laser Isotope Separation.	5
Isotope Separation by Resonance Radiation	5
Laser Tracking of Salyut-4.	6
Underwater Photometer.	6
Monograph on Hydrooptics.	7
Hydrobionic Studies Reviewed	7
Boundary Layer Flow vs. Body Shape of a Dolphin.	7
Study of Wideband Hydrophones	8
Review of Unmanned Underwater Vehicles	8
Laser-Generated Sound in Water.	9
Seismic Noise Recording With Laser Lightguide	9
R-i Generation of Geomagnetic Pulsations	10
R-f Effect on the Upper Ionosphere.	11
Oxygen electrode catalysts.	11
Large Cryoturbine Test.	11
Outlook for New Energy Sources.	11
Recent Publications.	13

Published by Informatics, Inc., for

Defense Advanced Research Projects Agency

S
O
V
R
a
D
ADA025929

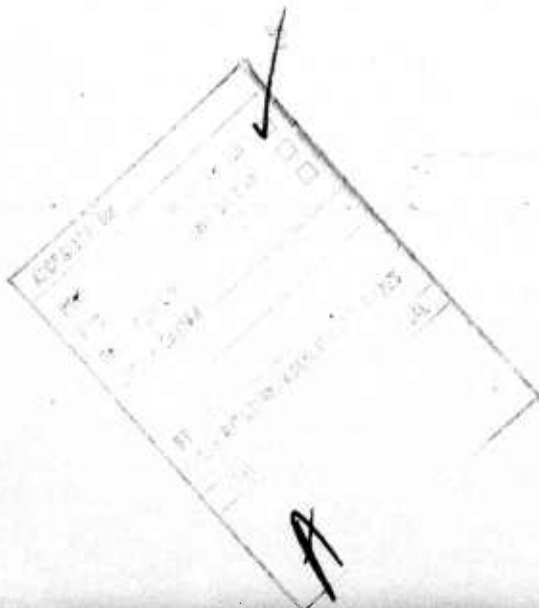
DARPA Order No. 3097, Amendment 1
Program Code No. 6L10, Program Element Code 62711E
Name of Contractor:
Informatics Inc.
Effective Date of Contract:
March 16, 1976
Contract Expiration Date:
September 17, 1976
Amount of Contract: \$109,724

Contract No. MDA-903-76C-0254
Principal Investigator:
Stuart G. Hibben
Tel: (301) 770-3000
Program Manager:
Ruth Ness
Tel: (301) 770-3000
Short Title of Work:
"Soviet R&D"

This research was supported by the Defense Advanced Research Projects Agency and was monitored by the Defense Supply Service - Washington, under Contract No. MDA-905-76C-0254. The views and conclusions contained in this document are those of the author and should not be interpreted as necessarily representing the official policies, either express or implied, of the Defense Advanced Research Projects Agency or the United States Government.

informatics inc

● Information Systems Company
● 6000 Executive Boulevard
● Rockville, Maryland 20852
● (301) 770-3000



REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle)		5. TYPE OF REPORT & PERIOD COVERED
SOVRaD - A Digest of Recent Soviet R&D Articles, Vol. 2, no. 4, 1976		Scientific ... Interim
6. AUTHOR(s)		7. PERFORMING ORG. REPORT NUMBER
Strat/Hibben, L/Boylan, J./Kourilo/M. Ness		15
8. PERFORMING ORGANIZATION NAME AND ADDRESS		9. CONTRACT OR GRANT NUMBER
Informatics Inc. 6000 Executive Boulevard Rockville, Maryland 20852		MDA-903-76C-0254
10. CONTROLLING OFFICE NAME AND ADDRESS		11. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
Defense Advance Research Projects Agency/TAO 1400 Wilson Boulevard Arlington, Virginia 22209		DARPA Order No. 3097, Amdt. 1. Program Code No. 6L10, Prog. El. Code 62711E
12. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		13. REPORT DATE
Defense Supply Service - Washington Room 1D245, Pentagon Washington, D. C. 20310		Apr 1976
14. DISTRIBUTION STATEMENT (of this Report)		15. SECURITY CLASS. (of this report)
Approved for public release; distribution unlimited.		UNCLASSIFIED
16. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		17. NUMBER OF PAGES
		14
18. SUPPLEMENTARY NOTES		
Scientific ... Interim		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number)		
Hydroacoustics, → Oceanography, Atmospheric Physics, → Dolphin Research, Laser Chemistry, → Energy Conversion, and Optical Sensors.		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number)		
This is a collection of brief abstracts on miscellaneous topics from the current Soviet technical literature. The intent is to supply a quick look at items of possible interest, including topics not necessarily named in the DARPA interest profile, as a supplement to our reportage on specified topics.		

INTRODUCTION

This is a collection of brief abstracts on miscellaneous topics from the current Soviet technical literature. The intent is to supply a quick look at items of possible interest, including topics not necessarily named in the DARPA interest profile, as a supplement to our reportage on specified topics.

It is intended to publish this collection on a monthly basis, to continue to provide prompt coverage of numerous aspects of Soviet R&D. As an added feature, all recently acquired books will be listed as they are received. A list of source abbreviations is appended.

For further information the reader is invited to call Stuart Hibben or Lee Boylan at Informatics on (301) 770-3000.

Academicians Predict Research Trends (abstract)

The March issue of the Academy's journal Vestnik carries a discussion of possible future fields of scientific interest. Several Academy members were interviewed with the following questions:

- o What problems in your field do you consider most important, in view of the Party's stated goal of developing the Soviet economy in the 1976-80 interval?
- o What do you think are the main ways of increasing scientific efficiency and of increasing its contribution to Communist society?
- o What is your view on possible approaches to improving the organization of scientists' efforts and of the management of scientific research organizations?

Speaking to the first question, A. Abrikosov, responding for the field of solid state physics, singles out two topics from the obviously wide range of possibilities. He gives top priority to high-temperature superconductivity, in view of the "colossal technical revolution" which HTS would generate. The most promising current candidates he describes as "quasi-one-dimensional organic substances, layered structures, and compounds with crystal lattices close to stability threshold". These avenues should be intensely pursued, but not to the exclusion of fresh ideas in HTS studies. (V. L. Ginzburg, prominent theoretician and a major force behind Soviet HTS studies, is however reported to have privately expressed pessimism on all present lines of their search for an HTS solution.)

The other field singled out by Dr. Abrikosov is the recently discovered new class of narrow-gap and gapless semiconductors and semimetals. This can lead to a new class of electronic devices with easily variable gaps, e. g. by an external magnetic field. Possible applications are new tunable lasers in the IR and submillimeter ranges, and electronic elements with several orders faster switch time, requiring only millivolts of supply and control voltage. Abrikosov warns, however, that development of this general category will demand an order of effort equal to that already expended in development of present-day semiconductor technology.

The only other scientist included in this interview was M. Kabachnik, speaking on organic chemistry, who also singles out two areas of maximum importance. The first is given as the problem of complex-formation (complexons) of phosphoorganic substances with metallic cations, including new phosphoorganic sorbents and extracting agents for separation and purifying of metals. The applicability of these materials is predicted to cover a wide range, from hydrometallurgy to medicine. Kabachnik's second candidate is new and improved pesticides with high specificity, low residual toxicity, etc. Recent improvements in synthesizing such compounds are said to be scheduled for field testing in the new 5-year plan. [Scientists speak. VAN, no. 3, 1976, 3-20].

Trends in Semiconductor Technology (abstract)

Two recent Soviet books undertake a review of new trends in semiconductor technology. The first of these is a semi-popular discussion, offered as one of a series of technical brochures being published under joint Soviet-Hungarian direction. The author, Ya. Fedotov, considers the possibilities in his "Semiconductor Electronics in the Year 2001" as an extrapolation of present state of the art, but without particular reference to levels of effort in the USSR or elsewhere. The bulk of the treatment is on modern semiconductor technology which is already proven in the field; using this criterion, the author does not attempt to discuss developments in advanced concepts such as Josephson junctions, nonlinear optics and others which are considered still in their formative stages. General operating principles are discussed of some advanced (hi-power, hi-frequency) transistors, phased antenna arrays, Schottky diodes, avalanche-transit diodes, acousto- and opto-electronics including liquid crystal and LED technology, charge-coupled devices, heterojunctions and superlattices. The few examples cited are of U. S. designs. A relatively extensive treatment is given to charge-coupling technology, mainly on its theory of operation. Fedotov cites memory applications, particularly in shift registers, as a most promising application of CCD's. The problem of reliability in integrated electronics is repeatedly touched on; in optoelectronics at least the author sees increased use of holography as an alternative to redundancy techniques for reliability, based on the fact that any discrete portion of a hologram contains all the basic information of the parent hologram.

In spite of the title, Fedotov declines any substantive prognostications, other than general observations to the effect that the laboratory wonders of today will become the household items of tomorrow, semiconductor electronics will play an increasing role in our daily lives, etc.

The second cited work, a collection of 27 papers issued under the title New Semiconductor Compounds and Their Properties, was published in 1975 by the Moldavian Academy of Sciences in Kishinev. These papers generally treat characteristics of prospective materials for semiconductor electronics, including application to miniature thermal converters and electrophotography. Data on optical properties of type A^{II}B₂C₄VI compounds, as well as on glassy As₂S₃ and bismuth based semimetals, are included. Generally, however, the compounds covered are not really new. Possible exceptions of interest might be work on photoluminescence of CdIn₂S₄ single crystals, and electrical properties of CdGeP₂ single crystals.

In summary, these two books can be said to reflect a widespread activity in current Soviet semiconductor studies, but do not indicate any particularly novel lines of research or development. [Fedotov, Ya. A. Poluprovodnikovaya elektronika god 2001-y. (Semiconductor electronics in the year 2001). Moskva, Sovetskoye radio, 1975, 104p. (LC). Novyye poluprovodnikovyye soyedineniya i ikh svoystva. (New semiconductor compounds and their properties). Izd-vo Shtiintsa, Kishinev, 1975 (LC).]

High-Sensitivity Superconducting Microwave Detector (verbatim)

A model of a millimeter and submillimeter wave detector was designed and constructed, using a superconducting point junction. Conditions were determined for obtaining high sensitivity and sensitivity spectral distribution over the 5 to 30 cm^{-1} frequency range. At 5 cm^{-1} frequency, up to 10^4 V/w and detection threshold was $5 \times 10^{-13} \text{ w/Hz}^{1/2}$, i. e. as good as the best InSb detector for this range. However, this is not the limit sensitivity. It can be significantly increased by minimizing noise and induction in the measuring circuit to the level of intrinsic noise of the junction, and by decreasing transmission losses. [Divin, Yu. Ya. and F. Ya. Nad'. Wideband microwave radiation detector, based on the Josephson effect. IN: Sb. Issledovaniya v oblasti radiotekhniki i elektroniki 1954-1974, p. 2. Moskva, 1975, 209-217. (RZhRadiot, 4/76, #4 Ye5730)].

Superconducting Microwave Frequency Converter (verbatim)

Response at intermediate frequencies was studied experimentally versus power levels of the UHF signal and heterodyne in a Josephson junction. Dynamic range is also evaluated. Conversion losses in the Josephson converter are compared in operation with an external heterodyne and with Josephson self-generation as the pumping source. Experimental data are compared with calculations using a resistance model of the junction. [Avakyan, R. S., A. N. Vystavkin, V. N. Gubankov and V. D. Shtykov. Down-conversion of microwaves in Josephson junction. ZhTF P, v. 1, no. 24, 1975, 1147-1151. (RZhRadiot, 4/76, #4 Ye579)].

New High-Strength Polymer Fibers (verbatim)

The possibility of obtaining polymeric liquid crystals is examined. The structure and viscosity characteristics of poly (p-benzocyclobenzene terephthalamide) and poly (p-phenylene terephthalamide) liquid crystals are given. Strength of fibers from these polymers approaches the theoretical value of $29.4 \times 10^3 \text{ MN/m}^2$ [Papkov, S. P. and O. A. Khanchich. A new branch of polymer science and technology. Khimicheskiye volokna, no. 5, 1975, 65-67. (RZhKh 19T, 4/76, #4T531)].

New Heat-Resistant Synthetic Fiber (Abstract)

A new fiber named Lola, retaining 40 to 50% of its original strength at 500°C in air, has been developed at the All-Union Scientific Research Institute of Fibers. The fiber does not ignite, nor burn in the flame of a propane burner (1200°C). It is resistant to chemical corrosion. The material may be used for electrical insulation and for fire-protective clothing. [Clothing from Lola fibers. IN: Khimicheskiye volokna, no. 3, 1975. (Khimiya i zhizn', no. 2, 1976, 47)].

Polymers as Structural Materials (verbatim)

The use of high polymers in h-f technology, e. g. antenna reflectors and filter plates, is given as an example of their potential application as structural materials. The required rigidity, weather resistance and dielectric characteristics are formulated. It is shown that high polymers modified with such materials as graphite, iron or iron carbonyl can be used to make low-cost antenna dishes and sandwich-type filters for a wide wavelength range in which the polymers act as active structural elements. It is concluded that high polymer characteristics are suitable for multifunctional structural elements in certain engineering applications. [Siggelkow, H. J. High-polymer materials in conjunction with methods of light element construction in manufacture of multifunctional structural elements. Plaste und Kautschuk, v. 22, no. 7, 1975, 584-587. (RZhKh 19T, 3/76, no. 3T298)].

Optical Processing of Side-look Sonar Signals (verbatim)

Operation is analyzed of an optical modulation correlation meter with spatial integration. The meter provides matching filtration of video signals from a coherent side-looking ultrasonic sonar. The inverse synthesis problem is solved to check principal parameters of the sonar. Theoretical data are compared with experimental data. [Astashov, I. K., V. G. Zakin, P. V. Kavzarin, G. I. Khokhlov, and A. V. Shisharin. Optical system for processing signals from an ultrasonic synthetic aperture sonar. IN: Sb. II Vsesoyuznaya konferentsiya po golografii. Tezisy dokladov, Part I. Kiyev, 1975, 123-124 (RZh Radiot, 3/76, #3Ye223)].

Calculation of Explosive Magnetic Field Compression Generators (abstract)

A generalized method is analyzed for computing parameters of explosion-driven field compression generators. The work is based on U. S. and Soviet publications on the subject dating back to 1967. The method obtains the required relationships among parameters of the generating circuit for which maximum energy is delivered to the load; the load is taken to be resistive and time-variable.

Analytical examples are given for planar generators, coupled to loads whose resistance varies linearly with temperature. The feasibility of designing such a generator is shown in which the power delivered in the resistive load $R(t)$ varies in a selected manner with time. In addition to power and energy, the discussion also examines the current pulse waveform as a function of different parameters of the generator circuit. [Lobanov, V. A. A method for calculating explosive magnetic generators. ZhPMTE, no. 1, 1976, 120-127].

Tunable Dye Laser for Isotope Separation (verbatim)

A liquid dye laser pumped by a "Samotsvet" lamp is described. The laser was developed at the Institute of Physics, Belorussian Academy of Sciences, and is designed for experiments in laser chemistry (isotope separation), spectroscopy, nonlinear optics, physics of the atmosphere and ocean, medicine, biology, and other applications. The laser operates over nearly the entire visible spectral region (400 to 750 nm). [Anufrik, S. S., S. P. Zabirko, V. S. Motkin and A. M. Rusetskiy. A liquid organic dye laser pumped by a "Samotsvet" lamp. IN: Sb. Materialy vsesoyuznoy konferentsii Lazery na osnove slozhnykh organicheskikh soyedineniy. Minsk, 1975, 217-219. (RZh Radiot, 4/76, #4Yel23)].

U. S. -Soviet Review of Laser Isotope Separation (abstract)

The first part of a joint Soviet-American review of literature on laser separation of isotopes has been published by V. S. Letokhov in collaboration with C. B. Moore of the University of California. Different known photochemical and photophysical methods of isotope separation are classified according to the mechanism of selective interaction of laser radiation with atoms or molecules. The methods are then reviewed systematically by established groups. Advantages of using laser radiation instead of noncoherent light are outlined in the introduction by Letokhov. Limitations of isotope excitation selectivity on account of isotopic shifts in atomic and molecular spectra and methods of increasing selectivity are treated by Moore. Letokhov covers the methods of selective multi-step atomic photoionization and two-step molecular photodissociation. Limitations of these methods and the search for ways of overcoming limitations are described. An example of a two-step selective photoionization of Rb atoms is given in a study to be published shortly by Letokhov et al. The last section by Moore deals with the method of selective molecular photopredissociation, its limitations and advantages. This method was used in a study [in print] by Letokhov et al to convert ortho- I_2 to para- I_2 . [Letokhov, V. S. and C. B. Moore. Laser isotope separation (A review). Part 1. Kvantovaya elektronika. no. 2, 1976, 248-287].

Isotope Separation by Resonance Radiation (abstract)

Researchers at LASL have recently described some promising progress in isotope separation technique, in which a uranium hexafluoride mix is passed through an expansion nozzle to obtain a supercooled gas. In this case the spectral state of the desired U^{235} is vastly simplified from the several thousand lines existing at room conditions, hence the possibility for statistically meaningful laser excitation of a given line or region is enhanced by the increased population at a given level. This method is offered as the first with potential for successful separation of isotopes as spectrally complex as those of uranium.

The LASL publication of results has prompted speculation as to whether the Soviets are showing any work along the same lines. A group under Basov at FIAN has studied the theoretical advantages of gas supercooling for isotope separation, and reported in 1975 on nozzle expansion of nitrogen isotopes to achieve separation (SOVRAD, no. 10, 1975, 5). However, use of this method

for the heavier isotopes, including uranium, has yet to be publicized. A related approach has however been suggested by two theoreticians, I. Krasnov and N. Shaparev, writing in an April issue of the Soviet Technical Physics Letters. The separation method suggested here depends on the fact that a low density gas can in fact be cooled as well as heated by proper selection of laser excitation. The resonance mechanism for doing this was reported by Haensch and Schawlow at Stanford in 1975; Krasnov and Shaparev expand on that model and establish the optimum criteria for gas cooling of a desired isotope. This ideally will be exponential and hence very rapid. A model is suggested for a two-isotope gas mixture flowing axially through a cooling cylinder, and exposed to selective laser radiation normal to the flow path. With reasonable assumed input parameters, the authors' calculations show a coefficient of separation of 10 to be obtainable.

The exercise is offered as an "encouragement to experimentalists", and there is no indication that Krasnov and Shaparev have tried to verify their idea. The paper was issued from the computer center at the Academy's Siberian Branch in Krasnoyarsk. [Krasnov, I. V. and N. Ya. Shaparev. Cooling of atoms by resonance radiation, and isotope separation. ZhTF P, no. 7, 1976, 301-305].

Laser Tracking of Salyut-4 (abstract)

A simplified description is given of an experiment in optical tracking of the Salyut-4 orbital station. A SKOL prototype stationary lidar was used in the experiment, characterized by pulse rate of 10Hz pulse energy of several tens of megawatts, and an antenna diameter of 1.5m. Six corner reflectors were mounted on the Salyut, each unit consisting of seven pyramids cut from quartz cubes. The diameter of the reflected laser beam is given as 20m.

Some aspects of the acquisition and tracking are described, and a functional sketch of the tracker is given. The exercise is described as a successful test of the new prototype lidar with its increased pulse repetition rate. [Danikov, V. Optical ranging of Salyut-4. Aviatsiya i kosmonavtika, no. 2, 1976, 40].

Underwater Photometer (abstract)

A description is given of the Kvant-2 universal underwater photometer, developed by the Institute of Physics at the Belorussian Academy of Sciences. It is offered as a reliable instrument for routine shipborne measurements of attenuation and scattering coefficients of light in water to a depth of 300m. It consists of a submersible unit with optomechanical and electronic circuitry, supply unit, self-recorder, and multicore cable. A support with extendable spherical mirror plus an aligning mechanism is mounted on the submersible unit. This feature makes it possible to reduce turbulence effects. A pressure indicator is attached to the submersible unit as well. The article gives descriptions of optomechanical and electronic functions as well as of measuring techniques. Examples of recorded vertical profiles of light attenuation and scattering coefficients are included. [Kozlov, V. D., and N. M. Samson. Instrument for measurement of light attenuation and scattering coefficients in water. ZhPS, v. 24, no. 3, 1976, 545-550].

Monograph on Hydrooptics (abstract)

An extensive new monograph has been issued on fundamentals of hydrooptics, based on the theory of e-m propagation through a turbid medium. Transfer theory methods are used for a quantitative analysis of an optical field in water, and for determining the primary hydrooptical parameters. The book analyzes features of energetic, angular, spectral and polarization distribution of sunlight, as well as internal narrow-beam sources, in the sea.

Particular emphasis is given to nonstationary scattering of radiation; the oscillatory nature of the optical field as a function of hydrosphere variations; and problems of ranging and viewing under water. Optical equipments currently used in ocean research are described, and the use of hydrooptics to solve various geophysical problems is discussed. The book includes reference material and specific recommendations for evaluating radiation fields in the sea. [Ivanov, A. P. Fizicheskiye osnovy gidrooptiki (Physical basis of hydrooptics) Minsk, Nauka i tekhn., 1975, 502p. (RZh Geofiz, 4/76, no. 4V105k)].

Hydrobionic Studies Reviewed (abstract)

A brief review of Soviet theoretical and experimental research covers 1968-74 publications on hydrodynamics of swimming propulsion of aquatic creatures, including fish, dolphins and squid. The dynamic theory of G. V. Logvinovich of the Ukrainian Academy of Sciences, is cited as the basis of recent experimental research. This theory makes it possible to calculate from experimental data the total traction, suction force, hydrodynamic resistance and efficiency of aquatic motion.

Soviet researchers have devoted a large effort to study of the speed and hydrodynamic characteristics of dolphins; in 1974, the maximum 11 to 12 m/sec swimming speed was recorded for a bottle-nosed dolphin. Further research has revealed the significance of elastic damping properties of dolphin skin, laminarized body shape, and nonstationary swimming characteristics in determining dolphin swimming hydrodynamics.

The finding that boundary flow laminarization is a selective function of swimming speed is cited as a new result of research. Another new result is that the Gray paradox exists only at certain swimming speeds, i. e., is selective. Formulation of the artificial muscle problem and the problem of direct conversion of chemical to mechanical energy are suggested as pertinent studies at the present time. There are 80 references, all but two of these Soviet. [Kozlov, L. F. and A. Ya. Oleynik. Results of hydrobionic research. Bionika, no. 9, 1975, 3-11].

Boundary Layer Flow vs. Body Shape of a Dolphin (abstract)

The turbulence in the horizontal component of fluctuation rate was measured at different points in the boundary layer of a bottle-nosed dolphin model. The hollow model was cast from reinforced epoxy resin and

was towed at speeds up to 5 m/sec in a test basin. The measured turbulence data are compared with those obtained earlier in the boundary layers of a live dolphin, a body of revolution model, and a vessel model.

A graphical comparison of the cited data indicates a transition from laminar to turbulent flow occurring with an increase in speed in the boundary layer of a live dolphin and its model, with a nearly invariant position of turbulence peaks on the turbulence vs. speed curves. Evaluation of the geometry versus speed profiles of the different test bodies shows that flow past the dolphin model is separated beyond the point with the relative coordinate $x/l = 0.67$, while flow past a live dolphin is a continuum in all points along the body up through $x/l = 0.75$. Thus the body shape of a dolphin governs the decrease in its hydrodynamic resistance; a live dolphin has the capability of preventing boundary layer separation. The experiment confirms that the negative pressure gradient formed around the body is a factor contributing to decreasing turbulence in the boundary layer. [Pyatetskiy, V. Ye. and V. M. Shakalo. Flow conditions in the boundary layer of a dolphin model. Bionika, no. 9, 1975, 46-50].

Study of Wideband Hydrophones (abstract)

An analysis is given of characteristics of wideband hydrophones (0.05 - 600 kHz) with piezoceramic spheres as a sensitive elements, together with methods of enhancing this response. Descriptions are given of two groups of hydrophones: those with sensitive elements made of type TBK-3 ceramic (diameters $R_1 = 50\text{mm}$ and $R_2 = 20\text{mm}$, with working frequencies up to 12 and 100 kHz, respectively); and those with sensitive elements made of type TsTS-19 ceramic ($R_3 = 6\text{mm}$ and $R_4 = 2.2\text{mm}$, working frequencies up to 150 and 600 kHz, respectively).

The analysis shows that frequency responses of the tested hydrophones fluctuate as follows: R_1 types, fluctuations are $\pm 2\text{db}$; for R_2 , $\pm 3.5\text{db}$; for R_3 , $\pm 3\text{db}$; and for R_4 , $\pm 1.5\text{db}$. A sharp drop in sensitivity around 40 KHz was ascribed to the rigid mounting of the sensitive element; this was eliminated by substituting rubber mounting rings. Directivity patterns of the hydrophones fluctuate as follows: for types R_1 and R_2 fluctuations are ± 0.5 and $\pm 1\text{ db}$, respectively; and for R_3 and R_4 , $\pm 0.5\text{ db}$. It is also noted that hydrophone frequency response can be improved by decreasing the wall thickness of the piezoceramic sphere. Thus if d_3 and d_4 are decreased respectively from 0.6mm and 0.4mm to 0.4 mm and 0.25 mm, fluctuations are reduced to $\pm 2\text{db}$ and $\pm 3\text{db}$; in addition the frequency range for the former hydrophone is extended to 200 kHz.

Thus the characteristics of hydrophones can be improved by adequate selection of mounting of the sensitive element, piezoelectric material, and dimension of the sensitive element. [Dyubchenko, M. Ye, and L. A. Davidenko. Study of wide-band hydrophones. Akustika i ul'trazvukovayatehnika, no. 10, 1975, 51-54].

Review of Unmanned Underwater Vehicles (abstract)

A recent book issued by the military publishing house Voenizdat covers numerous aspects of unmanned underwater apparatus. Nomenclature,

classification and structural details are given together with data on safety measures and implementation. The use of these vehicles in various underwater tasks is treated, as well as their economic effectiveness. Preparation and training of operators is also discussed. The material cited is from both Soviet and non-Soviet open literature. [Yurnev, A. P., A. V. Sytin, B. P. Bichayev, G. K. Krylov, V. V. Maksimov, and B. D. Sakharov. Unmanned underwater devices. Moskva, Voenizdat, 1975, 160p. (RZh Geofiz, 4/76, no. 4v16k)].

Laser-Generated Sound in Water (abstract)

Tests are reported on monitoring of monochromatic acoustic beams in water, generated by laser excitation. The acoustic field produced in water by intensity-modulated emission of a YAG laser, using a sinusoidally-driven Pockels cell, was measured in the near and far wave zones. Measurements are compared to calculations based on the models developed by Bozhkov et al. (1975) and Bozhkhov and Bunkin (1976).

In the near zone, the measured sound amplitude at the axis of the acoustic beam is about 12 millibars; the calculated amplitude for light intensity $I_0 = (15 \pm 3) \times 10^{-5} \text{ w/cm}^2$, and allowing for absence of a strict monochromaticity, is very close to this figure.

For the far zone, sound amplitude peaks when the absorption coefficient of laser emission ($\mu = 1\text{--}12 \text{ cm}^{-1}$) equals the acoustic wave number. Measured divergence of the acoustic beam was 0.19 - 0.2 rad, against a calculated value of 0.23 rad. The measurements thus confirm the validity of the theoretical models considered. [Bunkin, F. V., V. G. Mikhalevich, and G. P. Shipulo. Generation of monochromatic sound in water from absorption of laser emission. Kvantovaya elektronika, no. 2, 1976, 441-443].

Seismic Noise Recording With Laser Lightguide (verbatim)

Experiments are reported with long-baseline laser interferometers having up to 1.1 km path difference in the mirror section of an underground lightguide. Both equal and unequal-arm dual-beam Michelson interferometers were tested. In the 1 to 10 Hz range, fluctuations of 0.1 to 1 μm amplitude were observed with all interferometers; industrial seismic noise was the source of these readings. In the 0.001 to 1 Hz range, ambient atmosphere in the waveguide pipeline is the source of recorded fluctuations. In a 530 mm. diam. pipeline, noise intensity with an equal-arm interferometer was 3×10^{-9} to 5×10^{-9} and 2×10^{-10} to 3×10^{-10} relative units in winter and summer, respectively. Fluctuations in the cited frequency range and drift in an unequal-arm interferometer system depend on airtightness of the waveguide. Also, frequency instability of the laser has a significant effect.

The reported data indicate that an unsealed underground waveguide can be used in a system with an equal-arm interferometer for systematic measurements and recording of slow motion of the Earth's crust. As an example,

instrument recordings are given of long-period waves from the May 15, 1974 earthquake in the Kurile Islands. (Dubrov, M. N. Experimental study of instability of an underground mirror wavebeam guide line. IN: Sb. Vsesoyuznaya Konferentsiya po rasprostraneniyu radiovoln. P. 2. Tezisy dokladov. Kazan', 1975, 81-83. (RZh Radiot. 1/76, #1Y3504)).

R-f Generation of Geomagnetic Pulsations (abstract)

On the topic of local r-f heating of the ionosphere, A. M. Lyatskaya et al. have published a new theoretical study on the feasibility of using this method to generate artificial geomagnetic pulsations. The study is actually a rework of one done by J. Willis et al. (J. Geophys. Res., 1973, 78, 5710) on this possibility. Lyatskaya is critical of Willis' work and lists several factors that were not accounted for by him, which as a result caused Willis to be over-pessimistic on the requirements for artificial geomagnetic excitation.

The question is attacked by seeking the excitation level necessary to generate a geomagnetic pulse detectible above the normal background pulsation level, which in the stated interval of interest, 1 to 60 seconds, is taken to be 10^{-2} gamma. Since increase in local field is roughly proportional to increase in conductivity, it follows that one is looking for a source that will cause a local increase in conductivity of 10^{-2} mho or better, to have a detectible effect in the ionosphere.

The authors analyze this model for both the E- and F-layers, including factors omitted by Willis et al. They conclude that nighttime is a poor candidate for excitation: the E-layer is ruled out, and for practical purposes F-layer excitation would be barely above noise threshold. In the daytime ionosphere, however, both E- and F-layers could be excited readily, according to the assumed conditions. F-layer pulsations better than 20 times threshold are seen possible, and with sufficiently long driving pulse the same should hold true for the E-layer. The authors do not relate the excitation conditions to any transmitter parameters, but clearly conclude that a ground based r-f heater can induce appreciable geomagnetic pulsations. [Lyatskaya A. M., V. B. Lyatskiy, and Yu. P. Mal'tsev. Possible artificial generation of geomagnetic pulsations. GiA, no. 2, 1976, 331-336].

R-f Effect on the Upper Ionosphere (abstract)

Instability of an r-f wave front in the ionospheric F-layer is analyzed, under conditions of increased thermal conductivity and a strong plasma diffusion along magnetic force lines. Amplitude E of the electric field of a narrow r-f beam is described by a parabolic equation, with coefficients expressed as functions of the indices of refraction of ordinarily- and extraordinarily-polarized waves. The stability of the parabolic equation solution for E(y, z) is examined for the case of small perturbations along the X axis orthogonal to the (K, H) plane. [Vas'kov, V. V. and A. V. Gurevich. Modulation instability of radiowaves in the upper ionosphere. GiA, no. 2, 1976, 239-245].

Oxygen electrode catalysts (verbatim)

Experimental data are discussed on oxygen electrochemical reduction on dispersed positive and negative carbons and carbon-supported Co_3O_4 spinel. Experiments were carried out with a 3mm diameter rotating disk electrode in a 5mg/ml. 0.1N KOH suspension, in an O_2 or inert gas atmosphere. Differences in catalytic activity of the studied carbons were noted. Only one reduction step corresponding to a four-electron process was observed with the Co_3O_4 -promoted carbon material; this material exhibited the greatest catalytic activity. There were two reduction steps corresponding to the four- and two-electron processes with positive and negative carbons, the first process being predominant with the positive carbon. The negative carbon activity in the first reduction step is somewhat lower than that of mercury. The negative carbon, however, catalyzes the second step. [Kleymentov, B. V. Electrochemical catalysis with a dispersed electrode. IN: Moskovskiy energeticheskiy institut. Trudy, no. 248, 1975, 112-118. (RZhKh 19L, 1/76, no. 1L190)].

Large Cryoturbine Tested (abstract)

A news report briefly announces successful tests of a new superconducting turbogenerator, jointly designed by the Elektrosila combine and the Ukrainian Academy's Institute of Low Temperatures. The generator is designated as the KT-2-2; no figures are quoted, but it is described as the largest Soviet model built to date. Test results are claimed to be close to design expectations; a photo of the assembly is included. [Using superconductivity. Pravda, 13 March 1976, p. 2].

Outlook for New Energy Sources (abstract)

In a lecture to an October 1975 scientific session of the Academy of Sciences, physicist Peter Kapitsa discusses the problem of using alternative renewable energy sources. Development of high-power (on the order of 100MW) electrical engineering using solar, geothermal, hydraulic, wind or nuclear energy sources is shown to be limited, primarily, by the physical properties of the medium through which the energy flows in addition to the requirements of the fundamental laws of energy conservation and entropy increase. Such properties as diffusion rate, thermal conductivity, and mass of the transmitting medium all limit the energy flow density, thus making direct conversion of solar, geothermal, hydraulic, wind or chemical (fuel cell) energy into electrical energy technically and economically impractical on a large power scale. In this respect, indirect photochemical conversion of solar energy and underground nuclear-explosion stimulated geothermal conversions are suggested by Kapitsa as more promising. The greatest promise for solution of the impending energy crisis appears to be the use of nuclear energy; after citing technical, safety and political complications resulting from exploitation of atomic power plants, Kapitsa concludes that power generation from deuterium and tritium nuclei fusion remains the best specific solution to the imminent energy crisis.

Obstacles to realization of controlled nuclear fusion are discussed in terms of low energy transmission capacity of plasma electrons to ions, specifically in tokamak reactors. The recently proposed methods of heating ions in a tokamak are cited. Heating tritium or deuterium with laser pulses would greatly increase efficiency of the electron-to-ion energy transport and decrease time to 10^{-8} sec. Kapitsa sees the problem of fusion energy conversion as being solved after more detailed experimental study of hot plasma hydrodynamics. [Kapitsa, P. L. Energy and physics. UFN, v. 118, no. 2, 1976, 307-314].

Recent Publications

Besler, K., et al. Upravleniye nauchnymi issledovaniyami. (The management of scientific research). Moskva. Izd-vo Ekonomika, 1975, 189 p. (RBL, 3/4, 1976, #575).

Grishin, S. D., et al. Elektricheskiye raketnyye dvigateli: (Electric rocket engines). Moskva. Izd-vo Mashinostroyeniye, 1975, 272 p. (RBL, 3/4, 1976, #921).

Gromeka, V. I., et al. SShA: nauka i obrazovaniye [USA: Science and education]. Moskva. Izd-vo Nauka, 1974, 478 p. (RBL, 1/2, 1975, no. 549).

Kholodov, Yu. A. Reaktsii nervnoy sistemy na elektromagnitnyye polya. (Reaction of the nervous system to electromagnetic fields). Moskva. Izd-vo Nauka, 1975, 207 p. (RBL, 3/4, 1976, #617).

Kutsenko, A. V., et al. Mini-EVM v eksperimental'noy fizike. (Mini-computers in experimental physics). Moskva. Atomizdat, 1975, 285 p. (RBL, 3/4, 1976, #992).

Stafeyev, V. I., et al. Magnitodiody. Novyye poluprovodnikovyye pribory s vysokoy chuvstvitel'nost'yu k magnitnomu polyu. (Magnetodiodes: new solid state devices with high sensitivity to magnetic fields). Moskva. Izd-vo Nauka, 1975, 216 p. (RBL, 3/4, 1976, #707).

Venda, V. F. Inzhenernaya psikhologiya i sintez sistem otobrazheniya informatsii (Engineering psychology and synthesis of information display systems). Moskva. Izd-vo Mashinostroyeniye, 1975, 398 p. (RBL, 3/4, 1976, #1221).

SOURCE IDENTIFICATION

GiA	-	Geomagnetizm i aeronomiya
RBL	-	Russian Book List
RZhGeofiz	-	Referativnyy zhurnal. Geofizika
RZhKh	-	Referativnyy zhurnal. Khimiya
RZhRadiot	-	Referativnyy zhurnal. Radiotekhnika
UFN	-	Uspekhi fizicheskikh nauk
VAN	-	Akademiya nauk SSSR. Vestnik
ZhPMTF	-	Zhurnal prikladnoy mekhaniki i tekhnicheskoy fiziki
ZhPS	-	Zhurnal prikladnoy spektroskopii
ZhTF P	-	Pis'ma v Zhurnal tekhnicheskoy fiziki